Remarks

Claims 1-32 are currently pending in the Application and Claims 33-34 are newly presented herein.

Allowable Claims

The Applicant acknowledges with gratitude the Examiner's indication of allowability as to Claims 9, 12-23, and 31-32.

Specification amendments

The response amends paragraph at page 4, line 13 of the specification. Support for this amendment can be found, for example, in the originally submitted Figure 3b.

The response amends paragraph at page 8, line 24 to page 9, line 2 of the specification. Support for this amendment can be found, for example, in the originally submitted page 8 of the specification.

Claim amendments

This response amends Claim 27 to recite "wherein the electron sensitive resist layer nearest the substrate and the electron sensitive layer farthest from the substrate are less sensitive to the electron beam than the intermediate electron sensitive resist layer." Support for this amendment can be found, for example, in originally filed Claim 24.

New Claims

This response adds new Claims 33-34. The new claims are used to broaden the scope of the invention and are **not** offered in response to the Examiner's rejections. This response adds new Claims 33-34 to more completely claim the invention. Support for the new Claims 33-34 can be found, for example, in the original Claims 1, 24 and on page 5 lines 21-23 of the specification.

Specification objection

The Examiner objects to the specification because a word was corrected at the time of filling of the present application in ink. Applicant submits that page 8 of the specification has been amended to overcome the Examiner's objections as shown above. Applicant requests that the objection be withdrawn.

35 U.S.C. §112, second paragraph, rejection

Claims 27-28 stand rejected under 35 U.S.C. §112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. According to the Examiner Claim 27 recites a limitation with insufficient antecedent basis. Claim 27 has been amended to overcome this objection as shown above. Applicant requests that the rejection of Claims 27-28 be withdrawn.

35 U.S.C. §102(b) rejection

Claims 1-5, 8, 10-11 and 24-28 stand rejected under 35 U.S.C. §102(b) as being anticipated by Lai (U.S. Patent No. 5,766,967). Applicant respectfully disagrees.

The Examiner is reminded that "[a] claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference." MPEP 2131 quoting *Verdegaal Bros. V. Union Oil Co, of California,* 814 F.2d 628, 631, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987). The Examiner is also reminded that "[the] identical invention must be shown in as complete detail as is contained in the ... claim." MPEP 2131 quoting *Richardson v. Suzuki Motor Co.*, 868 F.2d 1226, 1236, 9 USPQ2d 1913, 1920 (Fed. Cir. 1989). Applicant submits that the Examiner has not shown that Kanber teaches each and every element as set forth in the rejected claims. In particular:

Claim 1

A. Applicant submits that the Examiner has not shown that Lai discloses, suggests or teaches, *inter alia*, at least the following features recited by Claim 1 of the present application:

"evaporating the **refractory metal** in the mold " (emphasis added)

The Examiner asserts that "the refractory metal" as recited in Claim 1 is disclosed by Lai's "Titanium." See page 3, section 7 of the Official Action. Applicant respectfully traverses the Examiner's assertion.

Applicant submits that refractory metals are considered to be those metals that melt at temperatures above 2123K. See print out from http://en.wikipedia.org/wiki/Refractory _metal, enclosed herein for the Examiner's ease of reference. Applicant further submits that Titanium has a melting point of 1933K. See print out from http://www.chemicalelements.com/elements/ti.html, enclosed herein for Examiner's ease of reference. How can the Examiner consider Titanium to be a refractory metal when Titanium's melting point is below 2123K?

The Examiner appears to rely on facts within his personal knowledge. Applicant respectfully requests, under 37 C.F.R. § 1.104(d)(2), that the Examiner provide an Affidavit supporting the Examiner's assertions. If the Examiner is relying on a prior art reference Applicant respectfully request that the Examiner cite the reference. Otherwise, Applicant respectfully requests that the assertion be withdrawn.

Applicant submits that the Examiner has not shown that Lai teaches, discloses or suggests "evaporating the refractory metal in the mold" as recited in Claim 1. Hence, Claim 1 is patentable over Lai and should be allowed by the Examiner. Claims 2-5, 8 and 10-11, at least based on their dependency on Claim 1, are also believed to be patentable over Lai.

B. Applicant also submits that the Examiner has not shown that Lai discloses, suggests or teaches, *inter alia*, at least the following features recited by Claim 1 of the present application:

> "wherein at least the first and third electron sensitive resist layers in the plurality of electron sensitive resist layers **maintain their shape <u>during</u> the step of evaporating the refractory metal in the mold**" (emphasis added)

The Examiner asserts that the "at least the first and third electron sensitive resist layers in the plurality of electron sensitive resist layers maintain their shape during the step of evaporating the refractory metal in the mold" as recited in Claim 1 is disclosed by

> "The total thickness of the three photoresist layers is about 0.5 to 1.5 μm. The thickness of the evaporated Schottky metal layers is about 3000 to 5000 Angstroms. During the metal liftoff, the wafer evaporated with metal layers is soaked in acetone. By doing so, the evaporated metal layers on top of the photoresist can be lifted off since all three photoresist layers can be dissolved in acetone. Furthermore, a thicker tri-layer photoresist can facilitate the metal liftoff, so that a well-defined submicron T-gate can be obtained and the fabrication yield of the devices using the present invention can be improved"

See page 3, section 7 of the Official Action. Applicant respectfully traverses the Examiner's assertion.

Applicant submits that the paragraph cited by the Examiner refers to metal liftoff step **<u>after</u>** the wafer has been evaporated with metal. See column 4, line s 35-37 of Lai. How can a paragraph disclosing a process that is **<u>after</u>** the wafer has been evaporated with metal, disclose or suggest that the "the first and third electron sensitive resist layers in the plurality of electron sensitive resist layers maintain their shape **<u>during</u>** the step of evaporating the refractory metal in the mold" as recited in Claim 1?

Applicant submits that the Examiner failed to comply with 37 C.F.R. §1.104(c)(2) which states:

> "In rejecting claims for want of novelty or for obviousness, the examiner must cite the best references at his or her command. When a reference is complex or shows or describes invention other than that claimed by Applicant, **the particular part relied on must be designated as nearly as practicable**. The pertinence, if not apparent, must be clearly explained and each rejected claim specified" (emphases added).

Applicant submits that the Examiner has failed to "designate as nearly as practicable" the particular part of Lai relied upon in making the assertion that Lai teaches that the "the first and third electron sensitive resist layers in the plurality of electron sensitive resist layers maintain their shape **<u>during</u>** the step of evaporating the refractory metal in the mold" as recited in Claim 1.

Applicant submits that the Examiner has not shown that Lai teaches, discloses or suggests "wherein at least the first and third electron sensitive resist layers in the plurality of electron sensitive resist layers maintain their shape during the step of evaporating the refractory metal in the mold" as recited in Claim 1. Hence, Claim 1 is patentable over Lai and should be allowed by the Examiner. Claims 2-5, 8 and 10-11, at least based on their dependency on Claim 1, are also believed to be patentable over Lai.

<u>Claim 24</u>

Applicant submits that, at least for the reasons stated above, the Examiner has not shown that Lai teaches, discloses or suggests "evaporating the refractory metal in the mold" and "wherein the electron sensitive resist layer nearest the substrate and the electron sensitive resist layer farthest from the substrate maintain there shape during the evaporation of the refractory metal" as recited in Claim 24. Hence, Claim 24 is patentable over Lai and should be allowed by the Examiner. Claims 25-28, at least based on their dependency on Claim 24, are also believed to be patentable over Lai.

<u>35 U.S.C. §103(a) rejection</u>

Claims 6-7 and 29-30 stand rejected under 35 U.S.C. §103(a) as being obvious in view of Lai and further in view of Minter (U.S. Patent No. 6,255,035).

A. Applicant submits that Claims 6-7 and 29-30, at least based on their dependency on Claims 1 and 24, respectively, are believed to be patentable over Lai and Minter, because there is no prima facie 35 USC 103(a) case based on Lai, as shown above, and because the Examiner has not shown to Applicant where Minter discloses, teaches or suggests the features not found in Lai.

B. Applicant also submits that the Examiner has **not** established a *prima facie* case of obviousness for the claims rejected under 35 U.S.C. §103(a). Applicant notes:

> "To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. **Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations.** The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, not in applicant's disclosure" (emphases added) *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991).

Applicant submits that a *prima facie* case of obviousness has not been established because the Examiner has failed to show that Lai and Minter teach each and every element as claimed in the present application.

<u>Claims 7 and 30</u>

Applicant submits that the Examiner has <u>not</u> shown that Lai and Minter disclose, suggest or teach, *inter alia*, at least the following features recited by Claim 7 and similarly recited by Claim 30 of the present application:

> "the plurality of electron sensitive resist layers are exposed to temperatures up to approximately **180°C during the evaporation** of the refractory metal" (emphasis added)

The Examiner asserts that the limitation of "the plurality of electron sensitive resist layers are exposed to temperatures up to approximately 180°C during the evaporation of the refractory metal" as recited in Claim 1 is disclosed by Minter's "photoresist ... soft baked at 170°C." See page 6, paragraph 4 of the Official Action. Applicant respectfully traverses the Examiner's assertion.

According to Minter, the photoresist, PMMA, is soft backed at 170°C **prior** to metal deposition in the manufacture of T-gate structure. See column 10, lines 26-54 of Minter. How can backing a photoresist at 170°C **prior** to metal deposition disclose or suggest that "layers are exposed to temperatures up to approximately 180°C **during** the evaporation" as recited in Claim 7?

Applicant submits that the Examiner failed to comply with 37 C.F.R. §1.104(c)(2) by not designating "as nearly as practicable" the particular part of Minter relied upon in making the assertion that Minter teaches that "layers are exposed to temperatures up to approximately 180°C **during** the evaporation" as recited in Claim 7.

Applicant submits that the Examiner has not shown that Minter teaches, discloses or suggests "the plurality of electron sensitive resist layers are exposed to temperatures up to approximately 180°C during the evaporation of the refractory metal" as recited in Claim 7 and similarly recited in Claim 30. Hence, Claims 7 and 30 are patentable over Lai and Minter and should be allowed by the Examiner.

Patentability of new Claim 33

New Claim 33 recites "wherein the at least the first and third electron sensitive resist layers maintain their shape during the step of evaporating the refractory metal in the mold when exposed to temperatures up to 180°C." Applicant submits that at least this feature is not disclosed by the prior art cited by the Examiner. Support for the new Claim 33 can at least be found in the originally submitted Claim 1 and on page 5 lines 21-23 of the specification. Hence, Claim 33 is patentable and should be allowed by the Examiner.

Patentability of new Claim 34

New Claim 34 recites "wherein the electron sensitive resist layer nearest the substrate and the electron sensitive resist layer farthest from the substrate maintain there shape during the evaporation of the refractory metal when exposed to temperatures up to 180°C." Applicant submits that at least this feature is not disclosed by the prior art cited by the Examiner. Support for the new Claim 34 can at least be found in the originally submitted Claim 24 and on page 5 lines 21-23 of the specification. Hence, Claim 34 is patentable and should be allowed by the Examiner.

Conclusion

In view of the above, reconsideration and allowance of all the claims are respectfully solicited.

The Commissioner is authorized to charge any additional fees which may be required or credit overpayment to deposit account no. 12-0415. In particular, if this response is not timely filed, then the Commissioner is authorized to treat this response as including a petition to extend the time period pursuant to 37 CFR 1.136 (a) requesting an extension of time of the number of months necessary to make this response timely filed and the petition fee due in connection therewith may be charged to deposit account no. 12-0415.

I hereby certify that this correspondence is being deposited with the United States Post Office with sufficient postage as first class mail in an envelope addressed to Mail Stop Amendments Commissioner for Patents POB 1450, Alexandria, VA 22313-1450 on

September 20, 2005
(Date of Deposit)

Shannon Tinsley
(Name of Person Signing)

S Tinsley
(Signature)

September 20, 2005
(Date)

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Encls:
Petition for a one-month extension of time and extension fee;
Fee for the excess claims;
Print out from:
http://en.wikipedia.org/wiki/Refractory_metal
Print out from:
http://www.chemicalelements.com/elements/ti.html;
Post card.

Refractory metals

From Wikipedia, the free encyclopedia.
(Redirected from Refractory metal)

Refractory metals are a class of metals extraordinarily resistant to heat, wear and corrosion. These properties make them useful in many applications. Household incandescent bulbs contain refractory metals in their tungsten filaments, and nearly all manufactured goods, particularly those containing metal or electronics, contain or were produced using refractory metals.

The five refractory metals are:

- Tungsten (W)
- Molybdenum (Mo)
- Niobium (Nb)
- Tantalum (Ta)
- Rhenium (Re)

Refractory metals are used in lighting, tools, lubricants, nuclear reaction control rods, as catalysts, and for their chemical or electrical properties. Because of their high melting point, refractory metal components are never fabricated by casting. The process of powder metallurgy is used. Powders of the pure metal are compacted, heated using electric current, and further fabricated by cold working with annealing steps. Refractory metals can be worked into wire, ingots, bars, sheets or foil.

Tungsten was discovered in 1781 by the Swedish chemist, Karl Wilhelm Scheele. Tungsten is both the most abundant of the refractory metals, and has the highest melting point of all metals, at 3,410C(6,170F). Tungsten wire filaments provide the vast majority of household incandescent lighting, but are also common in industrial lighting as electrodes in arc lamps. TIG-welding (Tungsten Inert Gas welding) or GTAW-welding (Gas Tungsten Arc welding) equipment uses a permanent, non-melting tungsten electrode. The most common use for tungsten is as the compound tungsten carbide in drill bits, machining and cutting tools. It also finds itself serving as a lubricant, antioxidant, in nozzles and bushings, as a protective coating and in many other ways. Tungsten can be found in printing inks, x-ray screens, photographic chemicals, in the processing of petroleum products, and flame proofing of textiles. Tungsten is also used by virtue of its strength and density, in applications ranging from weights in helicopter rotors and weapon projectiles to the heads of golf clubs. The largest reserves of tungsten are in China, with deposits in Korea, Bolivia, Australia, and other countries.

Molybdenum is the most commonly used of the refractory metals. Its most important use is as a strengthening alloy of steel. Structural tubing and piping often contains molybdenum, as do many stainless steels. Its strength at high temperatures, resistance to wear and low coefficient of friction are all properties which make it invaluable as an alloying compound. Its excellent anti-friction properties lead to its incorporation in greases and oils where reliability and performance are critical. Automotive constant velocity joints use grease containing molybdenum. The compound sticks readily to metal and forms a very hard, friction resistant coating. Most of the world's molybdenum ore can be found in the USA and Canada.

Niobium is nearly always found together with tantalum, and was named after Niobe, the daughter of the mythical Greek king Tantalus for whom tantalum was named. Niobium has many uses, some of which it shares with other refractory metals. It is unique in that it can be worked through annealing to achieve a wide range of strength and elasticity, and is the least dense of the refractory metals. It can also be found in electrolytic capacitors and in the

most practical superconducting alloys. Niobium can be found in aircraft gas turbines, vacuum tubes and nuclear reactors.

Tantalum is one of the most corrosion resistant substances available. Many important uses have been found for tantalum owing to this property, particularly in the medical and surgical fields, and also in harsh acidic environments. It is also used to make superior electrolytic capacitors. Tantalum films provide the most capacitance per volume of any substance, and allow miniaturization of electronic components and circuitry. Cellular phones and computers contain tantalum capacitators.

Rhenium is the most recently discovered refractory metal. It is found in low concentrations with many other metals, in the ores of other refractory metals, platinum or copper ores. It is useful as an alloy to other refractory metals, where it adds ductility and tensile strength. Rhenium alloys are being found in electronic components, gyroscopes and nuclear reactors. Rhenium finds its most important use as a catalyst. It is used as a catalyst in reactions such as alkylation, dealkylation, hydrogenation and oxidation. However its rarity makes it the most expensive of the refractory metals.

The creep behavior of refractory metals

Refractory metals and alloys attract the attention of investigators because of their remarkable properties and on account of promising practical prospects.

Refractory metals are characterized by their extremely high melting points, which range well above those of iron and nickel. When the refractory metals are considered to be those metals melting at temperatures above 2123 K, twelve metals constitute this group: tungsten (the melting point 3683 K), rhenium, osmium, tantalum, molybdenum, iridium, niobium, ruthenium, hafnium, zirconium, vanadium, and chromium.

Physical properties of refractory metals, such as molybdenum, tantalum and tungsten, their strength, and high-temperature stability make them suitable material for hot metalworking applications and for vacuum furnace technology. Many special applications exploit these properties: for example, tungsten lamp filaments operate at temperatures up to 3073 K, and molybdenum furnace windings withstand to 2273 K.

However, a poor low-temperature fabricability and an extreme oxidability at high-temperatures are shortcomings of the most refractory metals. Interactions with environment can significantly influence on their high-temperature creep strength. Application of these metals requires a protective atmosphere or a coating.

The refractory metal alloys of molybdenum, niobium, tantalum, and tungsten have been applied for the space nuclear power systems. These systems were designed to operate at temperatures from 1350 K to approximately 1900 K. An environment must not interact with the material in question. Liquid alkali metals as the heat transfer fluids are used as well as the ultrahigh vacuum.

The high-temperature creep strain of alloys must be limited for them to be used. The creep strain should not exceed 1-2%. An additional complication in studying creep behavior of the refractory metals is interactions with environment, which can significantly influence the creep behavior.

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[Date of Discovery](#)
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Element Groups:
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Periodic Table: Titanium

At Chemical Elements.com

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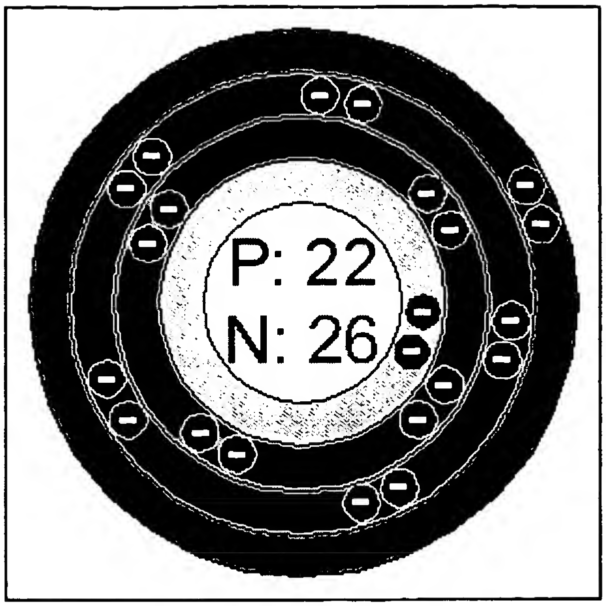
Basic Information

Name: Titanium
Symbol: Ti
Atomic Number: 22
Atomic Mass: 47.867 amu
Melting Point: 1660.0 °C (1933.15 K, 3020.0 °F)
Boiling Point: 3287.0 °C (3560.15 K, 5948.6 °F)
Number of Protons/Electrons: 22
Number of Neutrons: 26
Classification: Transition Metal
Crystal Structure: Hexagonal
Density @ 293 K: 4.54 g/cm^3
Color: silverish

Atomic Structure



Number of Energy Levels: 4

First Energy Level: 2
Second Energy Level: 8
Third Energy Level: 10
Fourth Energy Level: 2

Isotopes

Isotope	Half Life
Ti-44	52.0 years
Ti-45	3.07 hours
Ti-46	Stable
Ti-47	Stable
Ti-48	Stable
Ti-49	Stable
Ti-50	Stable
Ti-51	5.76 minutes

Facts

Date of Discovery: 1791
Discoverer: William Gregor
Name Origin: From the Greek word *titanos* (Titans)
Uses: paint, rubber, paper
Obtained From: minerals (ilmenite, rutile)

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1. About Titanium
   From the International Titanium Association
2. Titanium Data and Reference Manual
   from Titanium Industries, Inc.

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